APPENDIX B

PROCEDURE FOR DETERMINING THE MODULUS OF ELASTICITY OF UNBOUND GRANULAR BASE AND SUBBASE COURSE MATERIALS

B-1. Procedure.

a. The procedure is based on relationships developed for the resilient modulus of unbound granular layers as a function of the thickness of the layer and type of material. The modulus relationships are shown in figure B-1. Modulus values for layer n (the upper layer) are indicated on the ordinate, and those for layer n + 1 (the lower layer) are indicated on the abscissa. Essentially linear relationships are indicated for various thicknesses of base and subbase course materials. For subbase courses, relationships are shown for thicknesses of 4, 5, 6, 7, and 8 inches. For subbase courses having a design thickness of 8 inches or less, the applicable curve or appropriate interpolation can be used directly. For a design subbase course thickness in excess of 8 inches, the layer should be divided into sublayers of approximately equal thickness and the modulus of each sublayer determined individually. For base courses, relationships are shown for thicknesses of 4, 6, and 10 inches. These relationships can be used directly or by interpolation for design base course thicknesses up to 10 inches. For design thicknesses in excess of 10 inches, the layer should also be divided into sublayers of approximately equal thickness and the modulus of each sublayer determined individually.

b. To determine modulus values from this procedure, figure B-1 is entered along the abscissa using modulus values of the subgrade or underlying layer (modulus of layer n + 1). At the intersection with the curve applicable to this value with the appropriate thickness relationship, the value of the modulus of the overlying layer is read from the ordinate (modulus of layer n). This procedure is repeated using the modulus value just determined as the modulus of layer n + 1 to determine the modulus value of the next overlying layer.

B-2. Examples.

a. Assume a pavement having a base course thickness of 4 inches and a subbase course thickness of 8 inches over a subgrade having a modulus of 10,000 psi. Initially, the subgrade is assumed to be layer n + 1 and the subbase course to be layer n. Entering figure B-1 with a modulus of layer n + 1 of 10,000 psi and using the 8-inch subbase course curve, the modulus of the subbase (layer n) is found to be 18,500 psi. In order to determine the modulus value of the base course, the subbase course is now assumed to be layer n + 1 and the base course to be layer n. Entering figure B-1 with a modulus value of layer n + 1 of 18,500 psi and using the 4-inch base course relationship, the modulus of the base course is found to be 36,000 psi.

b. If, in the first example, the design thickness of the subbase course had been 12 inches, it would have been necessary to divide this layer into two 6-inch-thick sublayers. Then, using the procedure described above for the second example, the modulus values determined for the lower and upper sublayers of the subbase course and for the base course are 17,500, 25,500, and 44,000 psi, respectively.

c. The relationships indicated in figure B-1 can be expressed as follows for base course materials:

$$E_n = E_{n+1} (1 + 10.52 \log t - 2.10 \log E_{n+1} \log t)$$

where

n = a layer in the pavement system

E_n = resilient modulus (in psi) of layer n

E_{n+1} = the resilient modulus (in psi) of the layer beneath

t = the thickness (in psi) of layer n

The relationship can be expressed as follows for subbase course materials:

$$E_n = E_{n+1} (1 + 7.18 \log t - 1.56 \log E_{n+1} \log t)$$

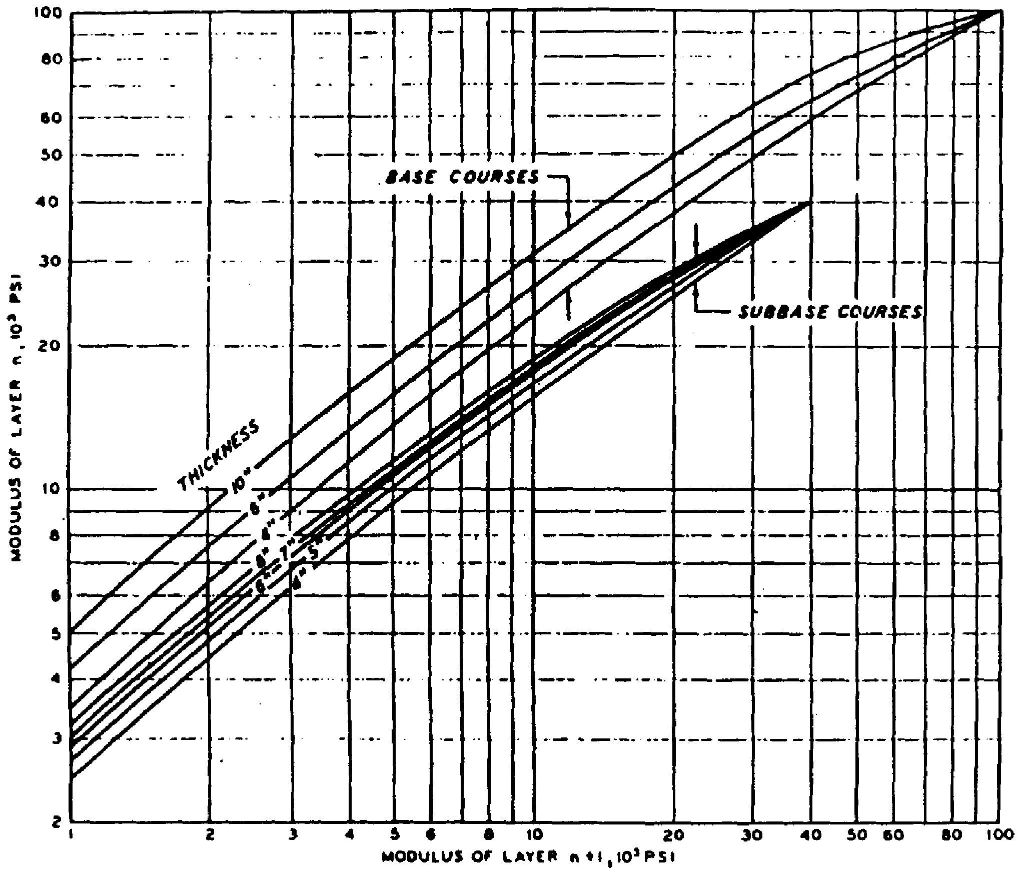

Figure B-1. Relationships Between Modulus of Layer n and Modulus of Layer n + 1 for Various Thicknesses of Unbound Base Course and Subbase Course.